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was at Montreal, either the same summer or in that of 1858, when I spent more than a month in or near that city. That difference of latitude, about three degrees, made what appeared to me a disproportionate difference in the frequency of auroral displays,—a difference, however, not as great as that between Montreal and Philadelphia, which is again a difference of latitude about five and a half degrees.

In high northern latitudes the auroral phenomena are rendered invisible a very large part of the year by twilight. At Montreal the twilight lasts until 10 o'clock and begins at 2; and on the Saguenay it ends at 11 o'clock and begins at 1. In latitude near 60° N. many years ago, in the month of June, I could read very easily at midnight by the light of the sun, which luminary seemed, by his bright rosy reflections against the clouds, to be but very little below the northern horizon. Plainly there can be but little chance for the electric aurora to shine among the rosy fingers of the due northern solar aurora. As in those regions the electric process causing the aurora occurs almost every night when there is little or no twilight, so we may presume the same process continues when a strong twilight hides the boreal aurora, especially since we know that auroras may be indicated by the magnetic needle when they are not actually visible to the eye. Our present reports from the far north lead to the supposition that the auroral process is more frequent on some meridians of longitude than on others, and that it is effected by geographical causes. Probably also many reporters, being exploring travellers and not scientific observers, have thought the fainter and less conspicuous auroras unworthy of record; and hence Prof. Loomis' small number of eighty per annum for the maximum average in any zone.

Both Capt. Franklin and Dr. Richardson testify that "the auroral phenomena are frequently seated within the region of the clouds." Hood states that he saw the aurora several times only six or seven miles above the earth's surface; among others, on Oct. 23, 1819, and June 13, 1820. I have observed similar cases. All the facts agree best with the idea that the liberation of the electricity causing the aurora takes place daily within the atmosphere, and that thence it escapes southerly by the three paths I have mentioned. The constant flow of electricity from the north requires in that region a constant supply. This supply must be afforded by the constant flow of the atmosphere to the north from the equatorial regions, where at its very start it is charged with electricity by simple evaporation from the saline waters of the oceans. For it is a well known fact that positive electricity abounds in all vapors from waters only slightly saline. It has long been remarked that terrestrial magnetism and atmospheric electricity seem intimately connected. They cannot depend on geological causes, for we see nothing in the mineral constitution of the globe to produce such variable phenomena. They must depend on the radiations from the sun, either directly in part by changes of temperature, as Faraday thought, or indirectly by some other means, such as evaporation, condensation, friction of atmospheric strata, and the like. Mysterious as the whole subject now appears, it is nevertheless plainly a soluble question, and awaits only the coming man armed fully with physical and meteorological science and having patience to give the problem a few years of undivided attention.

On the production of BRACTEA in LARIX.

BY THOMAS MEEHAN.

I have no desire to press with undue force on my fellow-students in Botany the importance of the discovery I made last year, that many of the great differences we see in varieties, species or even genera in Coniferæ, are resolvable into the simple question of axial vigor; but the key it furnished enables me frequently to unlock some heretofore secret and mysterious cabinet of nature, and I have, therefore, to keep referring to it as the means to still more important ends.

Last year I had progressed only so far as to learn that foliage was governed by this law. I have since been able to show that the production of the sexes is governed in the same way. I can now show that the same law prevails in determining the form of the parts of fructification.

Larix Europæa, as in these cones exhibited, has the bractea scarcely as long as the scales, but I also exhibit other cones from the same tree in which the bractea are double the length of the scales, and some of them inclined to recurve in such manner that they much more nearly resemble the cones of *Larix Griffithii* of the Himalayas than they do those of the species to which they belong. In order more clearly to explain the law of their production, I will go over again part of the ground I have before explored, in order to make more clear the connection between past discoveries and the present one.

In the first year of infant life, vitality is not strong. The *Larix* is no exception. As a consequence of this light hold on life, the leaves are all entirely free from cohesion with the main stem or axis. The next year life is more powerful,—the axis thickens, and the leaves become mostly adherent, having only the foliaceous awns free. The Larch, of all trees, devotes the most of its strength to its main axis or stem. Year by year it accumulates strength in it, until by ten or twelve years of age it will frequently be able to make a growth of five or six feet in height of a single season. At this—the height of its vigor—the reproductive age commences.

The greatest stream of vitality flowing through the main axis, the side branches have a very weak development. In many cases the buds cannot push forth into shoots at all, but in such cases that law which gives corresponding strength to the leaves in proportion as it is abstracted from the axis, causes the leaves—true leaves—to grow in tufts or verticils, on small woody spurs. The axis in these spurs elongates every year; by slitting them, the annual gains of growth can be readily seen. Occasionally, by the accidental breaking of the point of the branchlet along which these verticils are situated, or from some other cause, the stream of vitality along that line is checked, it will flow again into these verticils or arrested axes, and though they may have been in the condition of spurs for ten or twenty years, they will again develop into branchlets, with adherent leaves, as in the regular course of things.

Coming now to the bearing age, we find along a branchlet of the preceding year's growth, before the growing season commences, numerous buds at irregular distances along its length. The stoutest of these buds branch out into new branchlets; the rest remain as spurs. None of these produce flowers on this, the shoot of the preceding year; but the next year a few of the strongest again develop into branchlets, a few more into verticils of true leaves on the spurs, more into female, and the balance into male flowers. All these different grades of vigor, and the consequences of the various grades are apparent in these specimens (exhibited). The highest grade, the development of the axis with adnate leaves,—the next spurs with free leaves,—the third with fruiting cones,—the fourth with a vitality so weak that, after the production of the pollen, the flower and whole woody axis immediately dies altogether.

Let us now pass from the Larch to a law of vigor recognized by every observer as common to all trees. If two branches push out together, and the one happen to get a little the start of the other in vigor, the stream of vitality in that will be continually getting wider and stronger; and just in proportion will the other lose. The strong branch in time will often take all, absorbing all the feeders into itself, leaving the other side stream dry. Thus the inside branches of trees, deprived of light and air, get weaker; and the more fortunate ones thrive in proportion. In the Larch this is beautifully illustrated

The inside branchlets get gradually weaker, until spur after spur in successive years loses the power of forming verticillate leaves, *produces male flowers, the last effort of life*, and then expires. Clear as I think the illustrations in my previous paper were to show that the production of male and female flowers in Coniferæ was a mere question of a relative flow of vital force, nothing can better illustrate it than this one of the Larch.

I now come to the chief point of the present paper—the influence of these laws of vigor in the modification of the parts of fructification. You will see in some of these weaker shoots, which in the production of male flowers most of the spurs have performed the last sad offices of life, a few have had just enough extra vigor vouchsafed to them to produce female cones, and that it is just *these weak cones which produce the lengthened bracts.* I have compared with those of *Larix Griffithii.*

I have said in my paper on "Taxodium and Penus," in reply to an objection that my point as regards *Glyptostrobus sinensis* and *Taxodium distichum* being the same thing, is probably wrong, because the parts of fructification differ in each,—that as these parts of fructification are but modified leaves, the same law of change ought to operate on them as well. This instance of *Larix* proves it to be so. The bracts in Coniferæ are modified leaves, and the carpellary scales modifications of the woody axis. According to our now fully demonstrated theory, the leaves of Coniferæ are free, and become fully developed just in proportion to the weakness of the woody or axillary parts. This law might be expected to show itself in force in the bracts of the cone, as it is seen it really does in the specimens before us.

I am often asked what influence this law of vigor, as modifying form, is to have on our ideas of specific character? To me it seems the tendency will be to make our recognition of distinct things clearer, rather than to confuse them. As it is now, science on its present basis contradicts our senses. Every one knows a larch, a spruce, a fir, or a cedar, almost instinctively at sight; but no sooner were the rules of our best botanists applied to them, than no one knows which is which, and they are all thrown together in one genus. By pointing out the *directions of change* on one unvarying law, applicable equally to a whole genus or natural order, certainly affinities must be brought clearer and closer together, than by the present system of conjoining a few special points, many of which have no physiological relation to one another.

September 7th.

DR. RUSCHENBERGER, Vice-President, in the Chair.

Twenty-one members present.

Thomas Meehan said it was well known that all vegetable physiologists taught there were two classes of buds in plants, one called *adventitious* buds which had a kind of nomadic existence, springing anywhere from root or branch in apparent defiance of law or order,—the other *axillary* buds which were supposed to owe their origin to the leaf from the base of which they spring. It was customary to speak of these as the "parent leaves of the axillary buds." He would show that the leaf not only did not aid the axillary bud formation, but was rather a foe to bud development. He exhibited vigorous shoots of the Kentucky Coffee Tree, Honey Locust, Virginia Itea, Hickories and Walnuts, showing what had either been entirely overlooked by other botanists or passed over as of no importance, that there were in these two or three buds instead of the usual single axillary bud, one above another in a direct line, and that in all these instances the one the farthest removed from the base of the leaf, and of course the one the least under its influence, was the largest and best developed. These facts he had already incorporated in a paper read before the American Association at Salem last month. He